CLAIMS

What is claimed is:

1. A method of synthesizing stoichiometric LiBC by sufficient heating of elemental lithium, boron, and graphite uniformly-mixed within an inert gas atmosphere.

2. A method as recited in claim 1, wherein said heating comprises arc-melting of a pellet of said uniformly-mixed elemental lithium, boron, and graphite sufficient to trigger a self-propagating exothermic reaction

3. A method as recited in claim 1, wherein said heating comprises:

sealing uniformly-mixed elemental lithium, boron, and graphite (Li-B-C) in a tantalum ampoule; and

heating said tantalum ampoule in a heating chamber under sufficient temperature for a sufficient period of time.

4. A method of synthesizing stoichiometric LiBC, comprising:

mixing, uniformly, elemental mixtures of boron (B) and graphite powders (C) according to a suitable ratio under inert gas;

mixing lithium (Li) with boron (B) and graphite (C) under said inert gas;

pressing sealed mixture Li-B-C into a pellet; and

arc-melting said Li-B-C pellet to trigger a self-propagating exothermic reaction from which LiBC is created.

5. A method as recited in claim 4, wherein during exothermic reaction, excess lithium (Li), having served as a flux, is vaporized and released from compound.

6. A method as recited in claim 4, further comprising forming hole-doped $Li_{1-x}BC$ through vacuum de-intercalation.

7. A method as recited in claim 6:

wherein said de-intercalation of performed in a vacuum of approximately 10^{-6} torr;

wherein said de-intercalation is performed for approximately five (5) minutes to up to approximately one hundred (100) hours at approximately 600 °C to approximately 1200 °C.

8. A method as recited in claim 4:

further comprising adjusting the structure of $Li_{1-x}BC$ for $(0 \leq x < 1)$ by forming thin films of $Li_{1-x}BC$ over a substrate;

wherein stress induced on said substrate alters the electronic structure of said $Li_{1-x}BC$.

9. A method of synthesizing stoichiometric LiBC, comprising:

mixing, uniformly, elemental mixtures of boron (B) and graphite powders (C) according to a suitable ratio under inert gas;

mixing lithium (Li) with boron (B) and graphite (C) under said inert gas;

sealing said Li-B-C in a tantalum ampoule; and

heating said tantalum ampoule in a heating chamber under sufficient temperature for a sufficient period of time.

10. A method as recited in claim 9, wherein said tantalum ampoule heating comprises heating at approximately 1000 °C, annealing for approximately 10 hours, followed by cooling at a predetermined rate.

11. A method as recited in claim 10, wherein said cooling rate is approximately 3 °C/min.

12. A method as recited in claim 9, further comprising forming hole-doped compound $Li_{1-x}BC$ through vacuum de-intercalation.

13. A method as recited in claim 12:

wherein said vacuum is set to approximately 10^{-6} torr vacuum;

wherein said de-intercalation is performed for approximately five (5) minutes to up to

approximately one hundred (100) hours at approximately 600 °C to approximately 1200 °C.

14. A method as recited in claim 9:

further comprising adjusting the structure of $Li_{1-x}BC$ for $(0 \leq x < 1)$ by forming thin films of $Li_{1-x}BC$ over a substrate;

wherein stress induced on said substrate alters the electronic structure of said $Li_{1-x}BC$.

15. A method of synthesizing LiBC, comprising:

preparing elemental mixtures of lithium (Li), boron (B), and graphite (C) according to a predetermined ratio;

uniform mixing of said boron and said graphite powders;

loading said uniform mixture of boron (B) and graphite (C) powders into a dry box filled with inert gas and sufficiently mixing with lithium (Li);

pressing the Li-B-C mixture into a pellet; and

heating said pellet sufficient to trigger a self-propagating exothermic reaction.

16. A method as recited in claim 15, wherein said sufficient ratio is a ratio of Li : B : C ranging from the stoichiometric 1:1:1 to one with excess Li.

17. A method as recited in claim 15, wherein said sufficient ratio according to Li : B : C is approximately 1.3 : 1 : 1.

18. A method as recited in claim 15, wherein said lithium (Li) has a purity at or above 99.9%.

19. A method as recited in claim 15, wherein said boron (B) is amorphous with a purity at or exceeding 99.99%.

20. A method as recited in claim 19, wherein said boron comprises a powder of approximately 325 mesh.

21. A method as recited in claim 15, wherein said graphite (C) has a purity of approximately 99.9999%.

22. A method as recited in claim 21, wherein said graphite (C) comprises a powder of approximately 200 mesh.

23. A method as recited in claim 15, wherein said inert gas comprises argon gas or helium gas.

24. A method as recited in claim 15, wherein said lithium comprises elemental lithium from pieces freshly cut from an ingot inside said dry box.

25. A method as recited in claim 15, wherein said pressing comprises:

sealing said Li-B-C mixture into a die;

transferring said mixture outside the dry box in a press mechanism; and

pressing said Li-B-C mixture into a pellet.

26. A method as recited in claim 25, wherein pressing the Li-B-C mixture into a pellet comprises applying pressure over a period of time to achieve a sufficient pellet density.

27. A method as recited in claim 26, wherein said sufficient pellet density is achieved by applying a pressure of approximately 3000 pounds-per-square inch (psi) for a period of for approximately 10 minutes to a 6 mm die.

28. A method as recited in claim 15, wherein said heating of said pellet to trigger the exothermal reaction, comprises:

purging impurities from an arc furnace;

arc-melting of zirconium in said arc furnace to purify the inert atmosphere of said arc furnace;

loading said pellet under said inert atmosphere into said arc furnace; and

heating to a sufficient temperature under said inert atmosphere to trigger said

exothermal reaction.

29. A method as recited in claim 28, wherein said purging comprises argon gas-type purging followed by filling of the furnace with argon gas.

30. A method as recited in claim 15, wherein during said exothermic reaction, excess Li, having served as a flux, is vaporized and released from the compound.

31. A method as recited in claim 15, further comprising forming hole-doped $Li_{1-x}BC$ in a de-intercalation process under vacuum.

32. A method as recited in claim 31:

wherein said vacuum during intercalation is at approximately 10^{-6} torr;

wherein said de-intercalation is performed for approximately five (5) minutes to up to approximately one hundred (100) hours at approximately 600 °C to approximately 1200 °C.

33. A method as recited in claim 15:

further comprising adjusting the structure of $Li_{1-x}BC$ for $(0 \leq x < 1)$ by forming thin films of $Li_{1-x}BC$ over a substrate;

wherein stress induced on said substrate alters the electronic structure of said $Li_{1-x}BC$.

34. A method of synthesizing LiBC, comprising:

preparing elemental mixtures of lithium (Li), boron (B), and graphite (C) according to a predetermined ratio;

uniform mixing of said boron and said graphite powders;

loading said uniform mixture of boron (B) and graphite (C) powders into a dry box filled with inert gas and sufficiently mixing with lithium (Li);

sealing the Li-B-C mixture in a tantalum ampoule; and

heating the ampoule at a sufficient temperature for a sufficient time period to synthesize LiBC.

35. A method as recited in claim 34, wherein said sufficient ratio is a ratio of Li : B : C ranging from the stoichiometric 1:1:1 to one with excess Li.

36. A method as recited in claim 34, wherein said sufficient ratio according to Li : B : C is approximately 1.3 : 1 : 1.

37. A method as recited in claim 34, wherein said lithium (Li) has a purity at or above 99.9%.

38. A method as recited in claim 34, wherein said boron (B) is amorphous with a purity at or exceeding 99.99%.

39. A method as recited in claim 34, wherein said boron comprises a powder of approximately 325 mesh.

40. A method as recited in claim 34, wherein said graphite (C) has a purity of approximately 99.9999%.

41. A method as recited in claim 34, wherein said graphite (C) comprises a powder of approximately 200 mesh.

42. A method as recited in claim 34, wherein said inert gas comprises argon gas or helium gas.

43. A method as recited in claim 34, wherein said lithium comprises elemental lithium from pieces freshly cut from an ingot inside said dry box.

44. A method as recited in claim 34, wherein said heating comprises heating said ampoule to approximately 1000 °C at approximately 3 °C/min and annealing for approximately 10 hours.

45. A method as recited in claim 44, further comprising cooling of said ampoule at a predetermined rate.

46. A method as recited in claim 45, wherein said predetermined rate is approximately 3 °C/minute.

47. A method as recited in claim 34:

further comprising performing de-intercalation of said LiBC in an approximately 10^{-6} torr vacuum;

whereby hole-doped $Li_{1-x}BC$ is formed.

48. A method as recited in claim 47, wherein said de-intercalation is performed for approximately five (5) minutes to up to approximately one hundred (100) hours at approximately 600 °C to approximately 1200 °C.

49. A method as recited in claim 34:

further comprising adjusting the structure of $Li_{1-x}BC$ for $(0 \leq x < 1)$ by forming thin films of $Li_{1-x}BC$ over a substrate;

wherein stress induced on said substrate alters the electronic structure of said $Li_{1-x}BC$.

50. A method as recited in claim 49, wherein said stress-induced electronic structure alteration can control the superconductivity of said $Li_{1-x}BC$.

51. A method as recited in claim 49, wherein a thin-film deposition technique is utilized to form said layer of $Li_{1-x}BC$ on said substrate.

52. A method as recited in claim 51, wherein said thin film deposition technique can be selected from the group of thin-film deposition techniques consisting of evaporation, sputtering, pulsed laser deposition, pulsed electron deposition, molecular beam epitaxy, and electrochemical deposition.

53. A method as recited in claim 49, wherein said substrate has a similar crystal structure to that of LiBC toward inducing compressive, tensile, or zero strain.